UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: Updated Review of Rodenticide Incident Reports Primarily Concerning Children
DP Barcode D256673, Chemical #112701, 112001, 067707, 067701, 086002, 088601

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BACKGROUND

Earlier reviews of incident data on rodenticides have been prepared as listed below:

1. Updated Review of Poison Control Center Data for Residential Exposures to Rodenticides, 1993-1996. Prepared by Jerome Blondell, dated March 22, 1999.

2. Brodifacoum, Chlorophacinone, and Diphacinone. DP Barcode D231824. Prepared by Jerome Blondell and Monica Spann, dated September 9, 1997.

3. Review of Zinc Phosphide Incident Reports. DP Barcode D237711. Prepared by Jerome Blondell and Monica Spann, dated August 7, 1997.

4. Review of Bromadiolone Poisoning Data. Prepared by Jerome Blondell, dated August 2, 1995.

This review addresses the following six rodenticides: brodifacoum, bromadiolone, chlorophacinone, diphacinone, warfarin, and zinc phosphide and is intended to complement the first review listed above. The first review examined Poison Control Center data for the years 1993 through 1996. This review examines the other sources of information available on rodenticides including:

1) OPP Incident Data System (IDS) - reports of incidents from various sources, including registrants, other federal and state health and environmental agencies and individual consumers, submitted to OPP since 1992. Reports submitted to the Incident Data System represent anecdotal reports or allegations only, unless otherwise stated. Typically no conclusions can be drawn implicating the pesticide as a cause of any of the reported health effects. Nevertheless, sometimes with enough cases and/or enough documentation risk mitigation measures may be suggested.

2) U.S. Consumer Product Safety Commission's (CPSC) National Electronic Injury Surveillance System (NEISS) - The NEISS is a national sample of 101 hospitals from all U.S. hospitals with at least six beds and 24-hour emergency service. Hospitals are selected from a random sample stratified by hospital size and geographic location. Each hospital reports information on emergency treatments to the CPSC. Only cases seen in an emergency department are captured. Hospitalized cases (e.g., referred by a clinic) not seen in the emergency department are not included.

3) California Department of Food and Agriculture (replaced by the Department of Pesticide Regulation in 1991) - California has collected uniform data on suspected pesticide poisonings since 1982. Physicians are required, by statute, to report to their local health officer all occurrences of illness suspected of being related to exposure to pesticides. The majority of the incidents involve workers. Information on exposure (worker activity), type of illness (systemic, eye, skin, eye/skin and respiratory), likelihood of a causal relationship, and number of days off work and in the hospital are provided.

4) National Pesticide Telecommunications Network (NPTN) - NPTN is a toll-free information service supported by OPP. A ranking of the top 200 active ingredients for which telephone calls were received during calendar years 1984-1991, inclusive has been prepared. The total number of calls was tabulated for the categories human incidents, animal incidents, calls for information, and others.

5) Data from other States - The National Institute of Occupational Safety and Health provides funding to five states (California, Florida, New York, Oregon, and Texas) to investigate and report on occupationally-related pesticide illness. A small number of other States have active reporting of pesticide illnesses to their State Health Department, most notably Washington State.

Regular reporting of pesticide illness has only just gotten started in the past few years with the exception of Washington and Oregon who have each produced annual reports for several years.

The purpose of this additional review is to find information that might be useful in guiding the selection of risk mitigation measures. Among mitigation measures under consideration are adding bittering agent to the bait, adding a marking dye, making baits less accessible by using tamper-resistant bait stations, and outreach/education efforts to more effectively control rodents safely.

Additional information that would be desirable to guide selection of risk mitigation measures include:

1. The race and ethnic background of exposed cases. Is the language barrier a factor in exposures?
2. Are cases more likely to occur in poor, urban areas?
3. Do cases occur when the product is in use as a bait or when it is in storage?
4. What proportion of cases involve placement of bait by a commercial applicator as opposed to a homeowner?

RODENTICIDE REVIEW

1. Incident Data System

Please note that the following cases from the IDS do not have documentation confirming exposure or health effects unless otherwise noted.

Brodifacoum reports

Incident#7666-17

One pesticide incident, which was reported in an aggregate form, occurred in 1998 and resulted in minor symptoms. No further information on the disposition of the case was reported.

Incident#8384-308

A pesticide incident occurred in 1997, when a three year old ingested a brodifacoum product and reportedly had a swollen stomach. This case was classified as having a minor outcome. No further information on the disposition of the case was reported.

Incident#8384-313

A pesticide incident occurred in 1997, when a child experienced vomiting following ingestion. This cases was classified as having a minor outcome. No further information on the disposition of the case was reported.

Incident#8384-356

A pesticide incident occurred in 1998, when a fourteen month old child experienced hyperthermia (high body temperature) and diarrhea. No further information on the disposition of the case was reported.

In addition to the reports above describing cases involving children there were also four intentional cases and two unintentional cases in adults (Incident reference numbers #7694-1, #7893-1, #7930-1, # 8279-1, #8384-309, #8384-353). One of the intentional case involved a man who subsequently died from cerebral hemorrhage.

Bromadiolone reports

Incident#3828-1

Only one bromadiolone incident was reported in the Incident Data System based on a report to a Poison Control Center in 1996. This case was already fully captured in the earlier review by Blondell and Spann 1999.

Chlorophacinone reports

There were no incident reports involving children exposed to chlorophacinone in the Incident Data System. Two cases involved adults (Incident #4066-8 and #5041-1) including a man who died in his sleep due to pulmonary edema and severe hemorrhaging throughout his body. A container of chlorophacinone was found in his van. Possibility of suicide by ingestion not established or ruled out at the time of this report. No further information on the disposition of the case was reported. In the second adult case, a man inhaled chlorophacinone while cleaning a food pantry and experienced hiccups, nausea, insomnia, and vomiting. He was later hospitalized for hemorrhagic bleeding and pneumonia. No further information on the disposition of the case was reported.

Diphacinone reports

There were no incident reports involving children exposed to diphacinone in the Incident Data System. One adult case was reported (incident#7587-196) where a forty-three year old homeless woman ingested the chemical and was hospitalized. She experienced back and abdominal pain, hematemesis, and hematuria, and spontaneous bleeding from the mouth and nose. No further information on the disposition of the case was reported.

Warfarin reports

Incident#3403-1

A pesticide incident occurred in 1996, when a sixteen month old child was hospitalized after experiencing flu-like symptoms, stiffness, vomiting, convulsions, turned blue, seizure-like symptoms, feverish, and weakness. Symptoms were not consistent with known effects of

warfarin, which was not established as a causative agent in this case. No further information on the disposition of the case was reported.

Incident#3611-3

Poison Control Center from 1996 that was already captured in an earlier review.

Incident#5280-1

One Poison Control Center exposure reported in 1997 with no ill effects. No information on age, sex, or circumstances of exposure.

Incident#5468-1

One Poison Control Center report from 1997. No information on age, sex, or circumstances of exposure.

Incident#6736-1

One Poison Control Center report from 1998. No information on age, sex, or circumstances of exposure.

Zinc phosphide reports

There were no incident reports involving children due to zinc phosphide included in the Incident Data System. One incident involving adults (incident#6799-1) occurred in 1998, when seven employees were exposed to zinc phosphide after the chemical had been over applied (according to label rates) in a store. According to a newspaper article, zinc phosphide was applied to shelves and wall edges and near ventilation intake ducts. Some of the symptoms experienced by the employees were vomiting and diarrhea. No further information on the disposition of the case was reported.

2. U.S. Consumer Product Safety Commission's National Electronic Injury Surveillance System

The National Electronic Injury Surveillance System (NEISS) estimated 4,800 rodenticide exposures in children under five years of age in 1998. This estimate was based on 158 observed cases among the hospitals participating in the national sample. All of these cases were treated and released without being hospitalized. The U.S. Consumer Product Safety Commission also reported 64 observed cases of injuries in children under 13 years of age due to animal or insect traps. This was not enough cases to develop a reliable estimate, but it does illustrate the potential for injury from non-toxic forms of rodent control.

Interestingly, the earlier review of Poison Control Center data (Blondell, March 22, 1999 memorandum, Table 2) reported an average of 4,804 rodenticide cases per year seen in a health care facility involving children under age six. However, there are a number of important

differences between the NEISS estimate and the Poison Control Center data. The Poison Control Center data captures all visits to health care facilities not just emergency departments in hospitals. On average the Poison Control Center data captured 81% of the U.S. population whereas the NEISS estimate is intended to cover 100%. The Poison Control Center data is the actual observed number of cases seen, rather than an estimate and, as will be explained later in this paper, probably underestimates the true number of cases by a factor of four. Nevertheless, taking these various factors into account, the NEISS data does appear to provide some validation to the use Poison Control Center data as a basis for estimating the extent the extent of health care required for children exposed to rodenticides.

3. California Pesticide Illness Surveillance System - 1982 through 1995

California reporting is primarily oriented to capture information on occupational cases involving adults. Both adult and child cases are summarized below.

Brodifacoum cases

Detailed descriptions of 2 cases submitted to the California Pesticide Illness Surveillance Program (1982-1995) were reviewed. In the first case, a two and a half year old child ingested the chemical after picking up the product in a clothing store. The Pest Control Operator was issued a violation for placement of bait. Specific symptoms, if any, were not mentioned. In the second case, a worker was exposed after the product's contents blew into his face. He experienced discomfort and was diagnosed with acute accidental poisoning.

Bromadiolone cases

California did not report any bromadiolone cases from 1982 through 1995.

Chlorophacinone cases

A detailed description of 1 case submitted to the California Pesticide Illness Surveillance Program (1982-1994) was reviewed. In the one possible case, a worker placed chlorophacinone baits and experienced headaches, nausea, vomiting, and tremors. He was off work for three days on account of his illness.

Diphacinone cases

Detailed descriptions of 3 cases submitted to the California Pesticide Illness Surveillance Program (1982-1994) were reviewed. In the first case, a child swallowed diphacinone and the physician provoked vomiting. No other signs or symptoms were reported. In the second case, a worker was cleaning the ground with a blower and some of the chemical blew into his eyes. Specific symptoms were not mentioned. In the third case, a landscape maintenance worker was

hanging diphacinone blocks in a tree when something got into his right eye. He was not sure if the chemical got into his eye or something from the tree. He experienced a mild to moderate scleral injection of the right eye.

Warfarin cases

California reported 3 cases involving warfarin from 1982 through 1996. In one case (classified as probable) a child ate some warfarin which he found under the sink. The other two cases involved adults, one a despondent man who intentionally ingested the bait (classified as probable) and the second a warehouse worker who complained of stomach pains and inability to concentrate after handling items contaminated with warfarin (classified as possible).

Zinc phosphide cases

A detailed description of one case submitted to the California Pesticide Illness Surveillance Program (1982-1995) was reviewed. In the case, a store clerk unpacked a box of gopher killing material and the powder at the bottom of the box caused her to experience coughing.

4. National Pesticide Telecommunications Network

Brodifacoum reports

On the list of the top 200 chemicals for which NPTN received calls from 1984-1991 inclusively, brodifacoum ranked 44th with 87 incidents in humans reported and 113 incidents in animals (mostly pets). From April 1, 1995 through March 31, 1999 there was one case involving a child and five cases involving adults. The child was found with rodenticide in her mouth, but was thought not to have ingested the product. No symptoms were reported. The first adult case reports a male exposed to high levels with a low platelet level, but no further information on the circumstances of exposure or presence of symptoms. This case was classified as probable. The second adult case resulted from occupational exposure in a manufacturing/formulating facility which produced clotting problems (classified as a possible case). The third adult case had tightness in chest and daughter had headaches after a PCO applied product to their residence. Both of these cases are considered unlikely to be related to brodifacoum exposure. A 30 year old male cleaning a grain silo where brodifacoum was used reported became ill and was positive for exposure to brodifacoum (type of laboratory test and levels not reported). Exposure was by route of inhalation in this definite case. Specific symptoms not mentioned. In the fifth adult case a woman experienced nausea, fatigue, loss of breath, loss of appetite, and had nose bleeds after scattering pellets on her carpet and behind furniture. This case was classified as possible.

Bromadiolone reports

On the list of the top 200 chemicals for which NPTN received calls from 1984-1991 inclusively, bromadiolone ranked 82nd with 41 incidents in humans reported and 29 incidents in animals (mostly pets). From April 1995 through March 1999, the NPTN received approximately 6 calls concerning human health effects possibly related to bromadiolone. All six calls involved children, who may have ingested bromadiolone, but were not reported to have developed any symptoms at the time the NPTN was contacted.

Chlorophacinone reports

On the list of the top 200 chemicals for which NPTN received calls from 1984-1991 inclusively, chlorophacinone was not reported to be involved in human incidents. Nor were there any reports of incidents from April 1, 1995 through March 31, 1999.

Diphacinone reports

On the list of the top 200 chemicals for which NPTN received calls from 1984-1991 inclusively, diphacinone ranked 135th with 21 incidents in humans reported and 34 incidents in animals (mostly pets). From April 1995 through March 1999, the NPTN received approximately two calls concerning health effects in children possibly related to diphacinone. In the first call, a four year old child had difficulty breathing and his father experienced nausea and headaches after diphacinone was thrown down a trash shoot at their apartment building. In the second call, a woman experienced difficulty breathing and lost her voice after the chemical was sprinkled on the radiator, walls in the kitchen, behind the stove and several other areas in her apartment.

Warfarin reports

On the list of the top 200 chemicals for which NPTN received calls from 1984-1991 inclusively, warfarin ranked 75th with 50 incidents in humans reported and 52 incidents in animals (mostly pets). No incidents were reported in children from April 1, 1995 through March 31, 1999.

Zinc phosphide reports

On the list of the top 200 chemicals for which NPTN received calls from 1984-1991 inclusively, zinc phosphide ranked 165th with 16 incidents in humans reported and 9 incidents in animals (mostly pets). From April 1995 through March 1999, the NPTN received approximately one call concerning health effects in children possibly related to zinc phosphide. The one call involved the tracking powder being used in a preschool for mice. Teachers and children reportedly experienced vomiting, diarrhea, and nausea.

5. Data from other States

Brodifacoum reports

A pesticide incident occurred in New York, in 1990, when a one year old girl ingested an unknown amount of brodifacoum. She was asymptomatic and treated at a hospital with ipecac and activated charcoal. Her prothrombin time was normal.

A pesticide incident occurred in New York, in 1991, when a fifteen month old white boy ingested an unknown amount of brodifacoum after his family moved into a new apartment where the chemical was stored under a sink. The child was asymptomatic and treated at a hospital with ipecac, activated charcoal, and sorbitol. His prothrombin time was normal.

A pesticide incident, received from the Arizona Pesticide Program, occurred in 1993, when an eighteen month old boy ingested 15-18 pellets of brodifacoum. The child and his mother moved into a house and were unaware of the pellets that were left in the house from the previous occupant. The child's stomach was pumped and he was released from the hospital.

A pesticide incident, received from the Arizona Pesticide Program, occurred in 1994, when an eighteen month year old girl, who is white/Hispanic, crawled underneath a bed at a motel where she and her parents were staying. Rat poison in a brick form was believed to be underneath the bed. The parents were not sure if their daughter ingested the product and took her to the hospital where the doctor ran a prothrombin test and a complete blood count. Both tests were normal and the doctor stated that the child did not ingest the product.

Bromadiolone reports

No reports specific to bromadiolone were identified among NIOSH funded or other states contacted.

Chlorophacinone reports

No reports specific to bromadiolone were identified among NIOSH funded or other states contacted.

Diphacinone reports

No reports specific to bromadiolone were identified among NIOSH funded or other states contacted.

Warfarin reports

A pesticide occurred in 1993 in New York, when three white children, a four year old boy and his two year old sister, and a three year old boy, were found playing with warfarin in their home. All three children were asymptomatic.

Additional State data on rodenticides

Note that neither the Florida or Texas NIOSH funded programs reported investigating any rodenticide cases in children under six years of age. Florida reported that the Poison Information Center had 187 exposures to warfarin type anticoagulants and 1,027 exposures to long-acting anticoagulants in 1998. However, information on the age and active ingredient was not available. Texas reported nine exposures to rodenticides in their data, but none of these cases involved children under six.

The New York State Health Department examined hospital discharge records for 1990 through 1997. They selected unintentional (accidental) cases involving children under age six diagnosed with rodenticide poisoning. The ICD-9 (International classification of Disease, version nine) codes does not distinguish among rodenticides, so strychnine, and other unregistered products may be included along with the anticoagulants. A total of 143 discharges were reported over the eight year period in children under six years of age. For each case, the year, sex, race, ethnic background, and county was reported.

Poison Control Centers participating in the Toxic Exposure Surveillance System had coverage for the entire State of New York from 1993 through 1996. Looking at Poison Control Center data for those years, there were 11 cases hospitalized due to rodenticides in children under age 6 compared to 45 cases reported in E863.7 coding for NY hospitals. This means that Poison Centers captured no more than about 24% of the serious (hospitalized) cases. Note that some rodenticide cases captured as such by Poison Centers may not have been properly coded, so the actual extent of under-reporting may be somewhat lower than 24%. A study by Chafee-Bahamon et al. (1983) found that of 19,544 inpatient or outpatient cases seen in Massachusetts in 1979, 24% were referred to the State's Poison Control Center. A one year retrospective study in an urban hospital in Pennsylvania identified 470 toxic exposures of which 123 (26%) were referred to the local Poison Control Center in 1988 (Harchelroad et al. 1990). A much earlier report (Veltri et al. 1981) looking at inpatient and outpatient cases in Utah found that Poison Centers captured about a third of these cases. Note that these latter two studies are based on all ages, not just children.

With the additional information above it is possible to estimate a range for the number of children seen in health care facilities annually due to rodenticide exposures. The range of referrals from inpatient and outpatient cases to Poison Control Centers was 24-33%. The observed number of rodenticide cases seen in a health care facility and captured by Poison

Control Centers was 4,804 per year for 1993-1996 (of which 87% were due to anticoagulants). And the estimate of U.S. population served by Poison Control Centers over this time period was 81%. Thus, 4804/.81 divided by either 24% or 33% gives a range of approximately 18,000 to 25,000 children each year seen in a health care facility due to exposure to a rodenticide or a range of roughly 15,500 to 21,500 for anticoagulant rodenticides.

The New York data on hospitalized cases show an increased risk for blacks and Hispanics; those living in counties with a high percent urban (versus rural); and those living below the poverty level. From the hospital data, 57% of the cases were black compared to the State's black population of 15.9% in 1990 (a 3.6x risk). A total of 26% of the hospital cases were Hispanic compared to the State's Hispanic population of 12% (a 2.2x risk). The percent living below the poverty level in each county and the percent living in rural areas was calculated and multiplied by the number of hospitalized cases in each county. This procedure is subject to group aggregation bias (also sometimes called the ecological fallacy in epidemiology) and likely underestimates the true effect of the variables under study. Adding up the expected values for each county and dividing into State totals gives the following: 17.5% of the NY cases are estimated to have lived below the poverty level compared to 13% of the NY state population; 95.7% of the cases are estimated to live in urban areas, compared to 84.3% of the NY state population. Put another way, 7 urban counties (with 95% or greater urban population) account for 85% of the rodenticide cases in children under age six but just 55% of the NY State population.

The Washington State Department of Health reported a total of 330 childhood (less than six years old) ingestions of anticoagulant rodenticides from 1991 through 1995. There were just two cases during the same time period involving zinc phosphide. All of these incidents came from a Poison Control Center except two which came from the health care provider. Home owner use was involved in 317 (95%) of these cases. Non-commercial uses (e.g., Head start building, Mom's workplace, real estate open house) accounted for another 9 cases (3%) and the source of the rodenticide for the balance of cases (6) were unattributed.

VI. Conclusions

The additional information collected for this review was helpful in exploring some of the four questions listed at the beginning. Based on information from New York, hospital data suggest that race (black) and ethnic background (Hispanic) are significant risk factors for exposure of children under age six. In addition, the data from New York suggest that children who live in urban areas and below the poverty level are more likely to be exposed to rodenticides than the general population in that State.

In most of the data examined it was not possible to determine whether product applied by commercial applicator was a significant risk factor. However, data collected in the State of Washington suggests that this is at most a minor factor. The vast majority of cases involved a

non-professional placing the bait. A single case from California reported on a child poisoned by a bait improperly placed by a Pest Control Operator. However, California is much more likely to pick up occupational or enforcement-related cases. Cases involving homeowners are rarely, if ever, referred to enforcement for misapplication of a bait where children can find it.

The total number of estimated health care facility visits among children due to rodenticide exposures appear to be in the range of 18,000 to 25,000 per year or roughly 15,000 to 21,500 just for the anticoagulant rodenticides. This range is based on the number of health care related cases reported to Poison Control Centers for anticoagulants and other rodenticides, the percent of the U.S. population served by Poison Control Centers and the percent of hospital and/or emergency room cases that received referral to a poison center based on studies in four states.

Questions largely unaddressed by this review included whether language barrier was a factor in exposures and whether cases occur more often when the product is in storage or placed out as a bait.

VII. Recommendations

Funds provided to a Poison Control Center to gather additional data on a certain proportion of the reports of anticoagulant rodenticides could help answer key questions that remain unanswered or only partly answered. With assistance from CDC a one-page survey instrument could be developed and tested to measure the risk factors of interest. Estimated cost to conduct such a project is $125,000.

References

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cc: Correspondence
Brodifacoum file (chemical no. 112701)
Bromadiolone file (chemical no. 112001)
Chlorophacinone file (chemical no. 067707)
Diphacinone file (chemical no. 067701)
Warfarin file (chemical no. 086002)
Zinc phosphide file (chemical no. 088601)